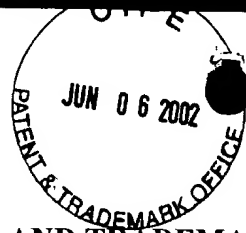


Docket No.: 49657-551



PATENT

Part of #12

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES**

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TECHNOLOGY CENTER 2800

In re Application of

Kazuhiro AIHARA, et al.

Application No.: 09/499,037

Group Art Unit: 2826

Filed: February 7, 2000

Examiner: J. Mondt

For: SEMICONDUCTOR DEVICE AND MANUFACTURING METHOD THEREOF

TRANSMITTAL OF APPEAL BRIEF

The Commissioner for Patents and Trademarks
Washington, DC 20231

Sir:

Submitted herewith in triplicate is Appellant(s) Appeal Brief in support of the Notice of Appeal filed April 18, 2002. Please charge the Appeal Brief fee of \$320.00 to Deposit Account 500417.

To the extent necessary, a petition for an extension of time under 37 C.F.R. § 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 500417 and please credit any excess fees to such deposit account.

Respectfully submitted,

MCDERMOTT, WILL & EMERY

Scott D. Paul
Registration No. 42,984

600 13th Street, N.W.
Washington, DC 20005-3096
(202) 756-8000 SDP:cac
Date: June 6, 2002
Facsimile: (202) 756-8087

TABLE OF CONTENTS



Page

I. <u>REAL PARTY IN INTEREST</u>	1
II. <u>RELATED APPEALS AND INTERFERENCES</u>	1
III. <u>STATUS OF CLAIMS</u>	1
IV. <u>STATUS OF AMENDMENTS</u>	2
V. <u>SUMMARY OF INVENTION</u>	2
VI. <u>ISSUES</u>	4
A. <u>The Rejections:</u>	4
B. <u>The Issues Which Arise In This Appeal And Require Resolution By The Honorable Board of Patent Appeals And Interferences (The Board) Are:</u>	4
VII. <u>GROUPING OF CLAIMS</u>	4
VIII. <u>THE ARGUMENT</u>	5
A. <u>The Rejection of Independent Claim 1 Under 35 U.S.C. § 103 for Obviousness Predicated Upon Alers 1 in View of Drynan</u>	5
B. <u>The Rejection of Independent Claim 2 Under 35 U.S.C. § 103 for Obviousness Predicated Upon Alers 1 in View of Alers 2</u>	10
C. <u>The Rejection of Independent Claim 3 Under 35 U.S.C. § 103 for Obviousness Predicated Upon Alers 1 in View of Nishioka</u>	13
IX. <u>CONCLUSION</u>	15
X. <u>PRAYER FOR RELIEF</u>	16
<u>APPENDIX</u>	17

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For: SEMICONDUCTOR DEVICE AND MANUFACTURING METHOD THEREOF

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Examiner: J. Mondt

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JUN 10 2002
TECHNOLOGY CENTER 2800

APPEAL BRIEF

The Commissioner for Patents and Trademarks
Washington, DC 20231

Sir:

This Appeal Brief is submitted in support of the Notice of Appeal filed April 18, 2002.

I. **REAL PARTY IN INTEREST**

The real party in interest is Mitsubishi Denki Kabushiki Kaisha.

II. **RELATED APPEALS AND INTERFERENCES**

Appellants are unaware of any related appeals and interferences.

III. **STATUS OF CLAIMS**

Claims 1-6 are pending in this application, and claims 1-5 have been finally rejected. It is from the final rejection of claims 1-5 that this Appeal is taken. Claim 6 is objected to as being

dependent upon a rejected base claim, but would be allowable if rewritten in independent form.

IV. STATUS OF AMENDMENTS

An Amendment was submitted pursuant to the provisions 37 C.F.R. § 1.116 on March 18, 2002, subsequent to the imposition of a final Office Action dated December 18, 2001. According to an Advisory Action dated March 28, 2002, the Amendment of March 18, 2002, would be entered if an Appeal is taken. As an Appeal has been taken, Appellants proceed on the basis that the Amendment of March 28, 2002, has been entered.

V. SUMMARY OF INVENTION

The present invention addresses and solves problems associated with the formation of a capacitor using polysilicon as a plug and lower electrode and tantalum oxide as a capacitor dielectric. Referring to Fig. 18, a storage electrode is formed from polycrystalline silicon film 103 formed in a contact hole of an interlayer oxide film 102. A capacitor dielectric film 104 formed from tantalum oxide (Ta_2O_5) covers the surface of polysilicon film 103 as well as a portion of an upper surface of interlayer oxide film 102. A cell plate electrode, consisting of a titanium nitride film (TiN) 105 is formed by chemical vapor deposition to cover the upper surface of tantalum oxide film 104 (page 1 of the written description of the specification, lines 14-28). Leakage current occurs when energy provided to electrons in the titanium nitride film 105 exceed a potential barrier, which is determined by a work function of the titanium nitride film 105 (page 1, line 29 through page 2, line 8). Furthermore, the process of forming the tantalum nitride film 105 over the tantalum oxide film 104 involves ammonia gas, which causes

a reduction of oxygen atoms in the tantalum oxide film 104. This, in turn, causes additional leakage current (page 2, lines 9-17).

According to the present invention, these problems are reduced, as recited in independent claims 1 and 2, by forming a storage electrode from tantalum nitride film, a capacitor dielectric film from tantalum oxide film, and a cell plate electrode from tantalum nitride film. By forming the contact plug from tungsten, oxidation of the upper surface of the contact plug is prevented, which occurs if polysilicon is used to form the storage electrode as with the conventional semiconductor device. This prevents additional capacitance as a result of the oxidation from being added to the capacitor (page 2, lines 9-16). Moreover, the tantalum nitride film formed on the tungsten film acts as a barrier and prevents counter diffusion between the tungsten film and the tantalum nitride film, which causes leakage current (page 2, lines 17-22).

The problems of the prior art are also reduced, as recited in independent claim 3, by forming a contact plug with tungsten, storage electrode from a first indium oxide film, a capacitor dielectric film from tantalum oxide film, and a cell plate electrode from a second indium oxide film. The use of indium oxide minimizes a reductive elimination reaction of the tantalum oxide film in the capacitor dielectric film during manufacturing. Accordingly, the elimination of oxygen atoms within the tantalum oxide film during manufacturing is reduced. Thus, a high degree of crystallinity is kept for the tantalum oxide film, and this reduces generation of leakage current (page 4, lines 17-27). Thus, the structure formed according to the present invention provides significant advantages over the prior art.

VI. ISSUES

A. The Rejections:

1. Claim 1 was rejected under 35 U.S.C. § 103 for obviousness predicated upon Alers, et al. (hereinafter Alers 1) in view of Drynan;
2. Claim 2 was rejected under 35 U.S.C. § 103 for obviousness predicated upon Alers 1 in view of Alers, et al. (hereinafter Alers 2); and
3. Claims 3-5 were rejected under 35 U.S.C. § 103 for obviousness predicated upon Alers 1 in view of Nishioka, et al. (hereinafter Nishioka).

B. The Issues Which Arise In This Appeal And Require Resolution By The Honorable Board of Patent Appeals And Interferences (The Board) Are:

1. Whether claim 1 is unpatentable under 35 U.S.C. § 103 for obviousness predicated upon Alers 1 in view of Drynan;
2. Whether claim 2 is unpatentable under 35 U.S.C. § 103 for obviousness predicated upon Alers 1 in view of Alers 2; and
3. Whether claims 3-5 are unpatentable under 35 U.S.C. § 103 for obviousness predicated upon Alers 1 in view of Nishioka.

VII. GROUPING OF CLAIMS

The appealed claims do not stand or fall together. Independent claim 1 stands or falls on its own; independent claim 2 stands or falls on its own; and claims 3-5 stand or fall together as a group.

VIII. THE ARGUMENT

A. The Rejection of Independent Claim 1 Under 35 U.S.C. § 103 for Obviousness
Predicated Upon Alers 1 in View of Drynan

On pages three and four of the statement of the rejection in the Office Action dated March 18, 2002, the Examiner concluded that the combined disclosures of Alers 1 and Drynan suggested the claimed invention.

The limitations of independent claim 1 are reproduced below:

- (i) a contact plug including a tungsten film in an upper portion of the contact plug, formed on a semiconductor substrate;
- (ii) a storage electrode including a tantalum nitride film formed on and contacting an upper surface of said tungsten film;
- (iii) a capacitor dielectric film including a tantalum oxide film formed on and contacting an upper surface of said tantalum nitride film; and
- (iv) a cell plate electrode including a tantalum nitride film formed on and contacting an upper surface of said tantalum oxide film.

As evident from these claim limitations, claim 1 is directed to a capacitor structure. The capacitor has two plates or electrodes (i.e., the storage electrode and the cell plate electrode), a dielectric film (i.e., the capacitor dielectric film), and a contact plug that is attached to one of the electrodes (i.e., the storage electrode). Although the basic structure (i.e., a capacitor) is not

novel, Appellants respectfully submit that the materials and the relationships between the materials used in the capacitor structure would not be obvious to one having ordinary skill in the art in view of the applied prior art.

Claim 1, in part, recites that the storage electrode includes a tantalum nitride film that is formed on and contact an upper surface of a tungsten film, which is part of the contact plug. As previously discussed herein in the "SUMMARY OF THE INVENTION," this claimed relationship between the tantalum nitride film and the tungsten film provides specific benefits.

In the statement of the rejection, the Examiner asserted that Alers 1 teaches a storage electrode that includes a tantalum nitride film. The Examiner also stated that "[Alers 1 does] not specifically teach the aforementioned via or contact plug 26 to include a tungsten film for low resistance." To solve this failure of Alers 1 to disclose the claimed invention, the Examiner asserted that "the use of tungsten for contact plugs in semiconductor integrated circuit capacitors has long been familiar to those of ordinary skills in the art, as witnessed by the publication [to Drynan]." Finally, on page nine of the Office Action, the Examiner then stated that one having ordinary skill in the art would have been motivated to use the structure of Drynan because of its low resistance combined with high-temperature resistance. However, although the Examiner pointed to the abstract of Drynan for the teaching of the desirability of tungsten, a review of the abstract of Drynan fails to yield this teaching.

Notwithstanding that Drynan teaches away from the claimed invention, which will be addressed in greater detail below, the Examiner has failed to establish that either reference would

have motivated one having ordinary skill in the art to form a capacitor, as claimed, comprising a tantalum nitride film on a tungsten film. Appellants note that it is legally erroneous to ignore any claim limitation. **Uniroyal, Inc. v. Rudkin-Wiley Corp.**, 837 F.2d 1044, 5 USPQ2d 1434 (Fed. Cir. 1988). However, the Examiner glossed over this limitation by stating:

Low resistance combined with high-temperature resilience (refractory property) is a well-known advantage for capacitor metal, largely explaining the popularity of tungsten in this art, irregardless whether the capacitor plug material is in contact with a tantalum nitride film as claimed by Applicant or not. (emphasis added)

The Examiner's rejection, put simply, is that specific materials recited in claim 1 for the capacitor structure are not unique, as shown by Drynan and Alers 1. As such, one having ordinary skill in the art would have been motivated to combine the tungsten plug of Drynan with Alers 1 because there are positive properties (i.e., low resistance) associated with using tungsten for a plug in a capacitor structure. This analysis, however, would equally apply to any possible conductive material that can be used as a plug in a semiconductor device. Furthermore, there are many other conductive materials having low resistance that can be used as a possible conductive plug, but the Examiner has failed to explain why one having ordinary skill in the art would zero in to the particular combination of materials being claimed. It is not enough for the Examiner to establish that one having ordinary skill in the art could have found this combination to be obvious. Instead, the Examiner is required to show that the claimed combination would have been obvious.

There is a significant difference between the use of "could" and "would" in determining what is obvious to one having ordinary skill in the art. Under a "*could* have found the invention to be obvious" analysis, almost any combination of materials in a standard structure (such as a capacitor) could be obvious. The reason being is that the Examiner is free to assert any token

benefit as a basis for using any material in the standard structure, and if such an analysis was acceptable, few patents would issue. However, the case law and the M.P.E.P. is clear that the Examiner must establish that the claimed invention would have been obvious over the applied prior art. The difference between "*could* have been obvious" and "*would* have been obvious" is manifested in the Examiner's burden of proof in determining patentability. The ultimate determination of patentability is based on the entire record, by a preponderance of the evidence, with due consideration to the persuasiveness of any arguments and any secondary evidence. **In re Oetiker**, 977 F.2d 1443, 24 USPQ2d 1443 (Fed. Cir. 1992). The legal standard of "a preponderance of the evidence" requires the evidence to be more convincing than the evidence which is offered in opposition to it. M.P.E.P. § 2142.

Notwithstanding the token benefit the Examiner has asserted for the motivation to modify Alers 1 in view of Drynan, the Examiner has failed to weigh the token benefit established by Drynan for the use of tungsten with the evidence that Drynan specifically teaches away from the claimed invention. In the second column, on page two of the Drynan article, it is stated that:

Likewise, a similar W/W layer used to fully plug via-holes to damascene W lines results in 40% reduction in resistance compared with W/TiN plug, due to both improved W crystallinity and elimination of the intervening high resistance TiN layer. These substantially reduced resistances demonstrate the advantage of bilayer W over conventional W/TiN for use in Logic local interconnections. (emphasis added)

Furthermore, although the Examiner points to Fig. 3 of Drynan for support, one of the captions in Fig. 3 is as follows: "Bilayer W virtual via/plug, cylindrical bottom electrode/plug." As such, Fig. 3 supports the notion that Drynan teaches the use of a bilayer W/W connection instead of a W/TiN connection. As previously argued, claim 1 requires that a tantalum nitride (TiN) film be formed on a tungsten (W) film. Therefore, how can the Examiner assert that one having ordinary skill in the art would have found the claimed invention obvious over the applied

prior art when Drynan teaches away from this specific limitation?

On page 10, in the statement of the rejection, the Examiner stated the following:

Many other examples could have been given of the wide use of tungsten as capacitor metal including plug material, both in the patent literature and in the textbook and journal literature. Therefore, the traverse of said rejection of claim 1 is found to be unpersuasive.

As clearly evident from this statement, the Examiner treats the applied prior art as a collection of features that can be reassembled without any consideration as to what is actually taught by the prior art. In this regard, the Examiner uses the features taught by applied prior art as a set of Legos[®] that can be reassembled in any manner. The Examiner has apparently made use of claim 1 as a blueprint for the purpose of reassembling these Legos[®] (i.e., features from the applied prior art) so as to arrive at the claimed invention. As previously demonstrated with the Examiner's treatment of Drynan, such an analysis ignores what is actually being taught by the reference.

Appellants respectfully submit that one having ordinary skill in the art would not have found the claimed invention over the applied prior art. Moreover, there are potent indicia of nonobviousness of record which additionally undermine the Examiner's obviousness conclusion.

Specifically, as previously pointed out, Drynan teaches away from the claimed invention, and this teaching away from the claimed invention constitutes an indicium of nonobviousness. **In re Bell**, 991 F.2d 781, 26 USPQ2d 1529 (Fed. Cir. 1993); **Specialty Composites v. Cabot Corp.**, 845 F.2d 981, 6 USPQ2d 1601 (Fed. Cir. 1988); **In re Hedges**, 783 F.2d 1038, 228 USPQ 685 (Fed. Cir. 1986); **In re Marshall**, 578 F.2d 301, 198 USPQ 344 (CCPA 1978).

Reference is also made to the first two full paragraphs on page three of the specification,

reproduced below.

Further, the contact plug is formed using the tungsten film. Therefore, it is possible to prevent oxidation of the upper surface of the contact plug, which would be inevitable during a manufacturing process when a polysilicon film is used to form the storage electrode as in the case of the conventional semiconductor device. This prevents formation of additional capacitance because of the oxidation of the upper surface of the contact plug. As a result, reduction of capacitance of the capacitor is suppressed.

Moreover, the tantalum nitride film offering an effective barrier is formed on the tungsten film. Thus, counter diffusion between the tungsten film and the tantalum nitride film is prevented. This restricts generation of a leakage current in the capacitor dielectric film due to the counter diffusion between the contact plug and the storage electrode. As a result, the charge retaining capability of the capacitor is improved.

These heretofore unrecognized benefits derived from the claimed invention constitute additional indicia on nonobviousness that must be considered in light of any obviousness conclusion.

Upon giving due consideration to the apparent incompatibility of Alers 1 and Drynan and the unrecognized benefits stemming from the claimed invention, the conclusion appears inescapable that one having ordinary skill in the art would not have found the claimed invention as a whole obvious within the meaning of 35 U.S.C. § 103. Appellants, therefore, respectfully submit that the imposed rejection of claim 1 under 35 U.S.C. § 103 for obviousness predicated upon Alers 1 in view of Drynan is not factually or legally viable and, hence, solicit withdrawal thereof.

B. The Rejection of Independent Claim 2 Under 35 U.S.C. § 103 for Obviousness Predicated Upon Alers 1 in View of Alers 2

On pages four and five of the Office Action, the Examiner asserted that Alers 1 teaches all of the claimed limitations except a copper film formed on an upper surface of a tantalum nitride film, which is taught by Alers 2. The Examiner also stated, with regard to Alers 2, the following:

the tantalum nitride layer or film 303 serves as top capacitor plate (column 5, lines 15-18), or cell plate

electrode as it is called in Alers 1, while a metal layer of film (numeral 308 in Alers 2) is formed on and contacts the upper surface of aforementioned tantalum nitride layer or film (numeral 303 in Alers 2). As possible material for the aforementioned metal layer or film Alers 2 mentions copper (column 4, lines 37-40)

Appellants respectfully submit that the Examiner's assertion in the underlined portion of the above excerpt is false. Although the Examiner uses reference numeral 308 as describing a metal layer, reference numeral 308 is in fact used to describe a cavity (column 3, line 33, 60-61), and Alers 2 does not mention that copper can be used for to fill the cavity 308. Also, column 4, lines 37-40 of Alers 2 states that:

As shown in Fig. 8, the window 706 is thereafter back-filled by standard technique with a layer of conductive material 801, such as tungsten or copper.

As shown in the subsequent Figures 9-10, the layer of conductive material 801 is planarized and etched to form feature 300. As stated in column 4, lines 8-10, "[t]he surfaces of the cavity 308 and surface 300 form the lower plate of the capacitor." As such, contrary to the Examiner's assertion, copper is not mentioned as a material to fill the cavity 308. Instead, copper is suggested as a possible material for the lower electrode.

Claim 2 recites "a copper film formed on and contacting an upper surface of said second tantalum nitride film." However, Appellants also note that neither Alers 1 nor Alers 2 teaches or suggests the formation of a copper film on a tantalum nitride film. Alers 1 makes no mention of copper, and the copper film 303 of Alers 2 only contacts a metal interconnect 304 and a tantalum oxide dielectric 302.

The Examiner's Legos[®] mentality with regard to combining features is again evident on page 10 of the statement of the rejection, during which the Examiner responded to previously-

presented arguments made by Appellants. In particular, the Examiner stated:

As mentioned before, low resistance is highly preferable and hence both copper and tungsten are often used interchangeably in capacitor metal components; copper having better thermal conductivity, tungsten having better high-temperature resilience.

It is well settled that a disclosed use of alternative materials for one purpose does not carry with it universal equivalence. See the relevant decisions of **In re Mercier**, 515 F.2d 1161, 185 USPQ 774 (CCPA 1975); **In re Vogel**, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); **In re Jezl**, 396 F.2d 1009, 158 USPQ 98 (CCPA 1968); and **In re Naylor**, 369 F.2d 765, 152 USPQ 106 (CCPA 1966). Thus, the Examiner has not established that one having ordinary skill in the art would have considered copper and tungsten as being interchangeable in this particular structure.

Another problem with the Examiner's analysis is that it ignores claimed interactions between various materials. For example claim 2 recites that a copper film in contact with a Ta₂O₅ film, and one benefit associated with the invention recited in claim 2 is the prevention of leakage current due to punch-through of electrons to a capacitor dielectric film (Ta₂O₅) that occurs because the copper film is used for the cell plate electrode in which electrons move at high speed (page 3, line 31 to page 4, line 10 of the specification). This benefit, however, has not been recognized by either Alers 1 or Alers 2, and one reason such a benefit has not been recognized is that neither Alers 1 nor Alers 1 teaches or suggests a copper film in contact with a Ta₂O₅ film.

For the reasons stated above, Appellants respectfully submit that one having ordinary skill in the art would not have found the claimed invention recited in claim 2 as a whole obvious within

the meaning of 35 U.S.C. § 103. Appellants, therefore, respectfully solicit the withdrawal of the imposed rejection of claim 2 under 35 U.S.C. § 103 for obviousness predicated upon Alers 1 in view of Alers 2.

C. The Rejection of Independent Claim 3 Under 35 U.S.C. § 103 for Obviousness Predicated Upon Alers 1 in View of Nishioka

On pages six through eight of the Office Action, the Examiner concluded that the combination of Alers 1 in view of Nishioka disclosed the invention as claimed.

Claim 3, in part, recites the following:

- (i) a contact plug including tungsten,
- (ii) a first indium oxide film (as a storage electrode) formed on the contact plug,
- (iii) a tantalum oxide film (as a dielectric layer) formed on the first indium oxide film,
- (iv) a second indium oxide film (as a cell plate electrode) formed on the tantalum oxide film.

The Examiner stated that Alers 1 discloses a basic capacitor structure (plug, storage electrode, dielectric layer, and cell plate electrode) with the dielectric layer including tantalum oxide film. The Examiner then used the extremely broad disclosure of Nishioka to teach that the storage electrode and cell plate electrode are both formed from indium oxide films and that the contact plug includes tungsten. As part of statement of the rejection, the motivation established by the Examiner to modify Alers 1 in view of Nishioka is "to proscribe storage and cell plate electrodes to include an indium oxide film and to proscribe the contact plug to include tungsten."

Appellants note that the requisite motivation to support the ultimate legal conclusion of obviousness under 35 U.S.C. § 103 is not an abstract concept, but must stem from the applied prior art as a whole and have realistically impelled one having ordinary skill in the art to combine specific references to arrive at a specifically claimed invention. **In re Deuel**, 51 F.3d 1552, 34 USPQ2d 1210 (Fed. Cir. 1995); **In re Newell**, 891 F.2d 899, 13 USPQ2d 1248 (Fed. Cir. 1989). The mere identification of claim features in disparate references does not establish the requisite realistic motivation to support the ultimate legal conclusion of obviousness under 35 U.S.C. § 103. **Grain Processing Corp. v. American-Maize Products Co.**, 840 F.2d 902, 5 USPQ2d 1788 (Fed. Cir. 1988). Moreover, a generalization does not establish the requisite motivation to modify a specific reference in a specific manner to arrive at a specifically claimed invention. **In re Deuel**, supra. Rather, a burden is imposed upon the Examiner to identify a source in the applied prior art for each claim limitations and identify a source for the requisite realistic motivation to modify a particular reference in a particular manner to arrive at a specifically claimed invention. **Smiths Industries Medical System v. Vital Signs Inc.**, 183 F.3d 1347, 51 USPQ2d 1415 (Fed. Cir. 1999); **In re Mayne**, 104 F.3d 1339, 41 USPQ2d 1451 (Fed. Cir. 1997).

The Examiner has failed to establish any realistic motivation whatsoever to combine Alers 1 with Nishioka. The number of possible combinations of materials disclosed by Nishioka for the contact plug, storage plate electrode, and cell plate electrode likely numbers in the tens of thousands if not greater. However, apparently using the Examiner's previously identified "Legos® mentality" with regard to combining features, the Examiner has plucked the combination of materials recited in claim 3 out of the thousands of possible combinations disclosed by Nishioka

and stated that this combination of materials recited in claim 3 would have been obvious in view of the combination of Alers 1 and Nishioka.

The Examiner has failed to consider the claimed limitations of a tantalum oxide film being contacted by two separate indium oxide films. In analyzing whether the claimed invention as a whole, the Examiner cannot consider the invention as only a collection of layers having different materials (i.e., the "Legos® mentality"). Rather, the Examiner must consider what is taught by the applied prior art, not only as to particular materials being disclosed, but also to the combination of materials being disclosed and how these materials interact with one another.

For the reasons stated above, Appellants respectfully submit that one having ordinary skill in the art would not have found the claimed invention recited in claim 3 as a whole obvious within the meaning of 35 U.S.C. § 103. Appellants, therefore, respectfully solicit the withdrawal of the imposed rejection of claim 3 under 35 U.S.C. § 103 for obviousness predicated upon Alers 1 in view of Nishioka. With regard to claims 4 and 5, which are dependent upon claim 3, Appellants incorporate herein the arguments previously presented with regard to claim 3. As such, claims 4 and 5 are also patentable over the applied prior art at least on the basis of their dependency on claim 3.

IX. CONCLUSION

It should, therefore, be apparent that the Examiner did not discharge the initial burden of establishing a prima facie case of obviousness under 35 U.S.C. § 103. Appellants, therefore, respectfully submits that the imposed rejections of claim 1-5 under 35 U.S.C. § 103 for obviousness

is not factually or legally viable and, hence, solicit withdrawal thereof.

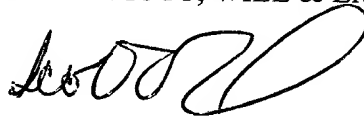
X. PRAYER FOR RELIEF

Based upon the foregoing, Appellants respectfully submit that one having ordinary skill in the art would not have found any of the claimed inventions obvious within the meaning of 35 U.S.C. § 103. Appellants, therefore, respectfully solicit the Honorable Board to reverse each of the Examiner's rejections under 35 U.S.C § 103.

To the extent necessary, a petition for an extension of time under 37 C.F.R. § 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 500417 and please credit any excess fees to such deposit account.

Respectfully submitted,

MCDERMOTT, WILL & EMERY



Scott D. Paul
Registration No. 42,984

600 13th Street, N.W.
Washington, DC 20005-3096
(202) 756-8000 SDP:cac
Date: June 6, 2002
Facsimile: (202) 756-8087

APPENDIX

1. A semiconductor device, comprising:

a contact plug including a tungsten film in an upper portion of the contact plug, formed on a semiconductor substrate;

a storage electrode including a tantalum nitride film formed on and contacting an upper surface of said tungsten film;

a capacitor dielectric film including a tantalum oxide film formed on and contacting an upper surface of said tantalum nitride film; and

a cell plate electrode including a tantalum nitride film formed on and contacting an upper surface of said tantalum oxide film.

2. A semiconductor device, comprising:

a storage electrode including a first tantalum nitride film formed over a semiconductor substrate;

a capacitor dielectric film including a tantalum oxide film formed on and contacting an upper surface of said first tantalum nitride film; and

a cell plate electrode including a second tantalum nitride film formed on and contacting an upper surface of said tantalum oxide film and a copper film formed on and contacting an upper surface of said second tantalum nitride film.

3. A semiconductor device, comprising:

a semiconductor substrate;

a contact plug including tungsten formed on the semiconductor substrate;

a storage electrode including a first indium oxide film formed on and contacting an upper surface of said contact plug;

a capacitor dielectric film including a tantalum oxide film formed on and contacting an upper surface of said first indium oxide film; and

a cell plate electrode including a second indium oxide film formed on and contacting an upper surface of said tantalum oxide film.

4. The semiconductor device according to claim 3, wherein said storage electrode further includes a tantalum nitride film formed beneath and contacting a lower surface of said first indium oxide film.

5. The semiconductor device according to claim 3, wherein said cell plate electrode further includes a copper film formed on said second indium oxide film.

6. The semiconductor device according to claim 5, wherein said cell plate electrode further includes a tantalum nitride film formed between said second indium oxide film and said copper film, contacting both said second indium oxide film and said copper film.